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Marked-Up Version of Substitute Specification

~~Description~~

~~Linear amplifier arrangement with non-linear amplifier element for a mobile radio device~~

SPECIFICATION

TITLE OF THE INVENTION

LINEAR AMPLIFIER ARRANGEMENT WITH NON-LINEAR AMPLIFIER ELEMENT FOR A MOBILE RADIO DEVICE

FIELD OF TECHNOLOGY

The ~~invention~~ present disclosure relates to a method and a device for optimizing the efficiency of an amplifier arrangement with a non-linear power ~~amplifier~~ amplifier, preferably in a mobile radio device.

BACKGROUND

As part of the further development of mobile radio from the GSM standard ~~through~~ to EDGE or ~~then~~ further on to the UMTS standard, new demands are being made on the transmission characteristics of power amplifiers. ~~Whereas previously the~~ Previously, information was transmitted as pure phase information (GMSK), however, recent developments require that the amplitude ~~is now~~be also evaluated for information transmission. This results in more stringent requirements for the transmission characteristics of ~~the~~ power amplifiers. On the one hand the amplifier element must be ~~extremely linear~~linear, and on the other hand the transmission characteristics must not depend on temperature changes and operating voltage variations. ~~This~~However, this is ~~however as a rule~~ not always the case ~~with a~~using ~~transistor~~ transistors. ~~To achieve this measures are thus required for minimizing~~ Often times linear and non-linear distortions need to be minimized. ~~This can for example be implemented in the form of~~ To achieve this, a pre-equalization in the base band or intermediate frequency or in the form of a closed loop such as a polar loop ~~for example. In in~~ is implemented. However, in each case a significant balancing and/or circuit overhead is required with such an arrangement.

~~The object of the present invention is to propose~~ Accordingly, an efficient and cost-effective amplifier arrangement is needed.

BRIEF SUMMARY

~~The object is achieved in accordance with the objects of the independent patent claims. Developments of the invention are specified in the subclaims. A core feature of the invention lies in the fact that in~~ The present disclosure illustrates an amplifier arrangement ~~with~~having a non-linear power amplifier (LV) and two successive push-pull phase modifiers ~~(PS)~~(PS), where a signal offset in phase to the input signal is generated in each case. ~~In this case after~~Afterwards, the phase modifiers power dissipation is converted at a passive component. The passive component is connected to the outputs of the phase modifiers. A passive component ~~can for example~~can, for example, be a load balancing resistor or a symmetrical transformer with a subsequent rectifier arrangement. After the power ~~amplifier~~amplifier, the amplitude-modulated signal is divided up into two signal parts of equal size or part powers and routed via two push-pull phase modifiers. The use of a symmetrical transformer as the component ~~represents an advantageous embodiment~~is particularly advantageous. The voltage uncoupled in the symmetrical transformer in this case is forwarded to a rectifier and the direct current output by the rectifier is routed to a supply unit as charge current. One advantage of this amplifier arrangement is that the efficiency of this arrangement can be decisively improved. ~~Furthermore~~ Furthermore, the present method and ~~the~~ arrangement of very cost effective.

BRIEF DESCRIPTION OF THE DRAWINGS

The various objects, advantages and novel features of the present disclosure will be more readily apprehended from the following Detailed Description when read in conjunction with the enclosed drawings, in which: ~~The invention will be explained in greater detail with reference to an exemplary embodiment shown in the figures. The individual diagrams show~~

Figure 1 illustrates a power amplifier with subsequent modulation feed and load balancing resistor, and

Figure 2 illustrates an amplifier arrangement for feeding back electrical energy to a supply unit of a mobile radio device.

DETAILED DESCRIPTION

Figure 1 shows an amplifier arrangement for implementing a linear amplifier system with non-linear amplifier components. Two phase modifiers PS controllable with ~~one~~a modulation signal are connected after a C-class power amplifier LV (where efficiency ~~that~~ can be realized in practice ~~appr.~~in the range of 75%). ~~In principal the~~ The circuit ~~works~~ of Figure 1 can be implemented with any class of amplifier (A, B or C~~), however~~C). However, the efficiency ~~is~~may be degraded with an amplifier LV operated other than in C class mode.

After the power amplifier ~~LV~~ LV, the generated signal or the power PRF is divided up into two part signals or part powers of equal size PRF 1 and PRF ~~2 and these~~ 2. These part powers are routed via the push-pull phase modifiers PS. ~~in~~In accordance with amplitude ~~information~~information, the power (RF) is converted as power dissipation in the load balancing resistor LAW. Amplitude information in this case is envelope curve information. The main disadvantage of this circuit arrangement also arises here. Corresponding to the crest factor (ratio of peak power to average power) the C-class power amplifier LV must be arranged for the peak power to be transmitted. However in such a circuit arrangement this leads to a large part of the RF power generated PRF being converted in the load balancing resistor LAW.

Figure 2 shows a amplifier arrangement for feeding back electrical energy to a supply unit of a mobile radio device. The power amplifier LV from Figure 1 can again be seen in this diagram operating in C-class mode with subsequent power separation PRF 1 and PRF 2 and the controllable phase modifiers PS. ~~In principal the~~ The circuit of Figure 2 works with any class of amplifier (A, B or C), however the efficiency ~~is~~may be degraded with a power amplifier LV operated other than in C mode. Omitted from this diagram is the load balancing resistor LAW which is replaced by a symmetrical transformer SÜ (ballun). ~~Furthermore~~ Furthermore, a rectifier arrangement GR connected to a direct current supply unit VE is added. The task of this new circuit arrangement is to route the dissipated power (HF) of the power supply unit (battery, ac adapter etc.) previously converted in the load balancing resistor LAW to a mobile radio device, and a mobile station for a cellular

mobile radio network, as direct current. After the power amplifier ~~LV the~~LV, power components PRF 1 and PRF 2 are routed via the phase modifiers PS. The electrical length or the throughput time of the power components PRF 1 and PRF 2 is influenced with ~~these~~ phase modifiers PS. ~~Thus for example~~ Thus, as an example, power component PRF 1 is increased in path 1 by phase modifier ~~PS~~PS, and the delay time in path 2 is reduced by the other phase modifier PS (push-pull). This is ~~conceivable~~achieved through two vectors which have the same phase angle before the phase modifier PS and are different after the phase modifier PS. This produces a different length of sum vector for the addition of the two subvectors before and after the phase modifiers PS as regards the amount. The phase modifiers PS are controlled by an amplitude modulation signal, ~~which for example~~ which, for example, can be an audio signal, video signal or similar information. The amplitude modulation signal can be decoupled from the input signal (useful signal). However it can also be any given signal. If the control voltage of the phase modifiers PS is not equal to zero, there is a voltage drop at the symmetrical transformer SÜ. The control voltage corresponds to the amplitude modulation signal and is thus zero when the modulation voltage is ~~zero Via~~ zero, via the symmetrical amplifier SU this voltage is transmitted on the secondary side of the transformer SÜ and referenced there to a potential. In this ~~example~~example, this is represented by a ground symbol. A reference to a battery ~~potential for example~~ potential, for example, is however also always conceivable. ~~Subsequently~~Subsequently, the voltage is rectified with a multipath rectifier and filtering is performed. The greatest ~~possible~~ efficiency is preferably obtained with a multipath rectifier. It would also be ~~conceivable~~possible to use another rectifier. The direct current set can then be fed to the supply unit VE. To ~~guarantee~~optimize the functionality of the overall circuit ~~it is important that~~ the input impedance of the rectifier GR ~~is~~should be almost independent of amplitude. If the input impedance of the rectifier is not constant, non-linear distortions are created which affect the function of the overall circuit. To transmit all signal components free of ~~distortion~~ distortion, the C amplifier LV ~~must be~~is designed for transmitting the maximum peak power occurring ~~to be able to be transmitted~~in the circuit. This means that the amplifier LV runs with a constant

power which lies above the average power required at the output by the crest factor. With ~~current~~ normal transmission ~~procedures~~ procedures, the crest factor lies in the range 3dB to 10dB. If the amplifier LV is dimensioned for a crest factor of 10dB, this means that for the arrangement with a load balancing resistor LAW (Figure 1), appr. 90 % of the generated power would be a converted in the load balancing resistor LAW as power dissipation. With the expanded circuit there is now the opportunity of capturing a this power dissipation component (HF) and feeding it to a supply unit VE as charge current. An HF (power dissipation) - DC (direct current) conversion is thus performed.

ABSTRACT

A ~~particularly simply and cost effective way~~ system and method to optimize the efficiency of an amplifier device is provided by the ~~inventive method and device for optimizing the efficiency of an amplifier device with~~ including a non-linear amplifier ~~(IV)~~ in a mobile radio device. ~~The invention is characterized in that a~~ A phase displaced signal in relation to the input signal is respectively produced in the amplifier device with a non-linear power amplifier ~~(IV)~~ and in ~~two~~ a plurality of push-pull successive phase modifiers ~~(PS)~~, and the outputs of the phase modifier ~~(PS)~~ are connected by a passive component ~~(SU-LAW)~~.

This listing of claims will replace all prior versions, and listings, of claims in the application:

Listing of claims:

Claims 1-20 (canceled).

Claim 21 (new): An apparatus for optimizing the efficiency of an amplifier arrangement comprising:

a non-linear power amplifier in a mobile radio device; and

a plurality of push-pull phase modifiers coupled to said amplifier, wherein said phase modifiers generate a signal offset in phase form an input signal and wherein the outputs of the phase modifiers are coupled to a passive component.

Claim 22 (new): The apparatus according to claim 21, wherein a symmetrical transformer included in the amplifier arrangement is used as the passive component.

Claim 23 (new): The apparatus according to claim 21 wherein power is obtained at the passive component after the phase modifiers.

Claim 24 (new): The apparatus according to claim 21, wherein an amplitude modulated signal is generated by the amplifier arrangement by means of fed amplitude information.

Claim 25 (new): The apparatus according to claim 21, wherein a load balancing resistor is used in the amplifier arrangement as the passive component.

Claim 26 (new): The apparatus according to claim 22, wherein a voltage is decoupled in the symmetrical transformer that is rectified in a rectifier, and wherein the direct current output by the rectifier is fed to a supply unit as charge current.

Claim 27 (new): The apparatus according to claim 25, wherein power is dissipated in load balancing resistor.

Claim 28 (new): The apparatus according to claim 21, wherein the push-pull phase modifiers are controlled using a modulation signal.

Claim 29 (new): The apparatus according to claim 27, wherein the power dissipation is referenced in a symmetrical amplifier to a voltage potential.

Claim 30 (new): The apparatus according to claim 21, wherein a signal generated by the power amplifier is divided into two part signals of equal size and fed to the plurality phase modifiers.,

Claim 31 (new): The apparatus according to claim 26, wherein the input impedance of the rectifier is amplitude-independent.

Claim 32 (new): The apparatus according to claim 26, wherein a single-path or multipath rectifier is used as the rectifier.

Claim 33 (new): The apparatus according to claim 21, wherein the maximum peak power arising in the power amplifier can be transmitted with a deviation of up to 6 dB.

Claim 34 (new): The apparatus according to claim 21, wherein the transmitted power of the power amplifier is up to 6 dB around the crest factor above the average power required at the output.

Claim 35 (new): The apparatus according to claim 31, further comprising a supply unit coupled to the power amplifier, wherein the supply unit is one of a battery and an ac adapter.

REMARKS

The present amendment makes editorial changes and corrects typographical errors in the specification, which includes the Abstract, in order to conform the specification to the requirements of United States Patent Practice. No new matter is added thereby. Attached hereto is a Substitute Specification including a marked-up version of the changes made thereto via by the present amendment.

In addition, the present amendment cancels original claims 1-20 in favor of new claims 21-35. Claims 21-35 have been presented solely because the revisions by red-lining and underlining which would have been necessary in claims 1-20 in order to present those claims in accordance with preferred United States Patent Practice would have been too extensive, and thus would have been too burdensome. The present amendment is intended for clarification purposes only and not for substantial reasons related to patentability pursuant to 35 U.S.C. §§101, 102, 103 or 112. Indeed, the cancellation of claims 1-20 does not constitute an intent on the part of the Applicants to surrender any of the subject matter of claims 1-20.

Early consideration on the merits is respectfully requested.

Respectfully submitted,

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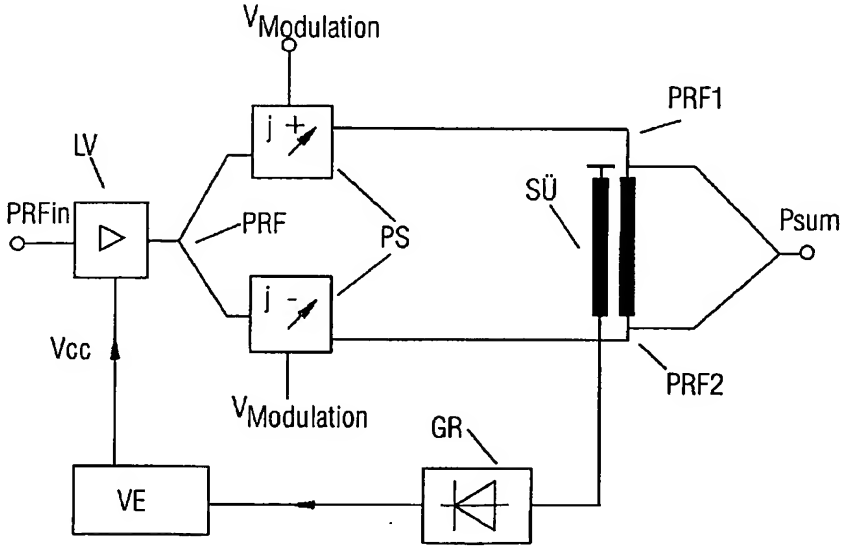
[Fortsetzung auf der nächsten Seite]

(54) Title: LINEAR AMPLIFICATION DEVICE WITH A NON-LINEAR AMPLIFICATION ELEMENT FOR A MOBILE RADIO DEVICE

(54) Bezeichnung: LINEARE VERSTÄRKERANORDNUNG MIT NICHTLINEAREM VERSTÄRKERELEMENT FÜR EINE MOBILE FUNKEINRICHTUNG



(57) Abstract: A particularly simply and cost-effective way to optimize the efficiency of an amplifier device is provided by the inventive method and device for optimizing the efficiency of an amplifier device with a non-linear power amplifier (LV) in a mobile radio device. The invention is characterized in that a phase displaced signal in relation to the input signal is respectively produced in the amplifier device with a non-linear power amplifier (LV) and in two push-pull successive phase modifiers (PS), and the outputs of the phase modifier (PS) are connected by a passive component (SU, LAW).

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